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ORIGINAL ARTICLE

TO COMPARE THE MICROLEAKAGE IN CAVITIES RESTORED WITH NANOHYBRID COMPOSITE BY USING THREE DIFFERENT PLACEMENT TECHNIQUES: AN IN VITRO STUDY

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ABSTRACT:
The aim of the study was to compare the microleakage along the margins of composite restoration in class II cavities using horizontal increment, oblique increment and bulk placement technique. Methods and Material: standardized class II cavities were prepared in 30 extracted human permanent molars. The teeth were restored with nanohybrid composite (Tetric N Ceram) and bonding with adhesive systems (3M ESPE Adper Single Bond 2 adhesive) using three different placement techniques. Microleakage evaluated after thermocycling (500 cycles) of the specimens. Statistical analysis: One way ANOVA test was used for inter comparison of microleakage between the groups at the 0.05 level of significance and multiple comparison by Tukey test were used. Results: Mean microleakage score of group I- 1.20, group II- 1.05 and group III -2.75 Conclusions: None of the insertion techniques used in this study was able to prevent microleakage, though the lowest microleakage values were obtained when the oblique incremental technique was used.
Keywords: Horizontal increment, oblique increment, bulk placement, polymerization shrinkage, microleakage, thermocycling.

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INTRODUCTION:

The performance of dental restorations is influenced by several factors, which include the choice of restorative material, the clinician's level of experience, the type of tooth, the position of tooth in the dental arch, the restoration's design, the restoration's size and the number of restored surfaces and also the patient's age.[1]

In the last decade there has been a significant growth in the use of tooth-colored materials even for posterior teeth restorations. An improved conventional glass ionomer cements, composite resins, resin-modified glass ionomer cements, light cured glass ionomer cements, silver reinforced glass ionomer cements and polyacrylic acid modified composites (compomers) have become available in addition to amalgam restorative material and stainless steel crowns[1]as an option for restoration of class II cavities.

Resin composites are increasingly used for restorative purposes in the dentistry because of good esthetic and the capability of establishing a bond to enamel and dentin. The color stability, wear, fracture resistance of these materials have been greatly improved since their introduction about 50 years ago.[2] The cavity preparation required for the composite restoration is also less invasive and less extensive.[3]

However, these materials have impediments related to marginal integrity and leakage due to the polymerization shrinkage.[4] The extension of the polymerization shrinkage depends on multiple factors such as the configuration factor, composition of resin composites, material properties.[4]

Different restoration placement techniques are widely recognized as a major factor in the modification of shrinkage stresses.[5,6] To reduce stress generated by polymerization shrinkage, it is often recommended to apply and cure composite resins in layers.

To reduce polymerization shrinkage and stress effects various incremental techniques also have been recommended by reducing the bulk of composite cured with each layer, and it is generally recognized that for the overall size and cavity configuration many different insertion techniques are recommended[7] in which include occluso-gingival layering, oblique layering, facio-lingual layering, centripetal placement technique, vertical,

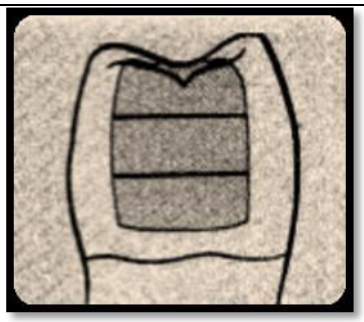
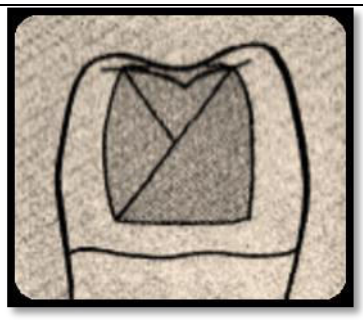
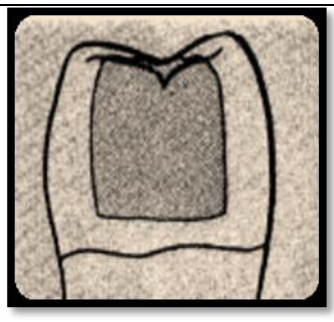
horizontal, wedge shaped (oblique), successive cusp build up technique.
Among these horizontal incremental technique, oblique incremental technique, and bulk filled technique are commonly used techniques for cavity restoration in recent clinical practice. Studies available with comparing the microleakage of these techniques is limited and often have given contradictory results.
Therefore the study was conducted to compare the microleakage in proximal region in class II cavities restored with a nanohybrid composite (Tetric N Ceram) and bonding with single bottle self etch adhesive systems (3M ESPE Adper Single Bond 2 adhesive)) using three composite placement techniques (horizontal oblique increment, oblique increment and bulk technique).

MATERIALS AND METHODS:
A total number of 30 freshly extracted, caries and restoration free molars were selected for this study. The thirty standardized Class 2 (MOD) cavities at the mesial and distal surfaces of each tooth were prepared. The cervical wall was placed at the cemento-enamel junction. The preparations were made with using a No. 245 carbide bur (SS White), under copious water coolant, in a highspeed handpiece.
The final preparations had the following dimensions: 2.0-mm occlusal extension, 3.0-mm bucco-lingual extension, and 5.0-mm occluso-cervical extension. The extension of cavity preparation was measured by the vernier calliper.
The samples were divided into three equal groups of ten teeth each according to the type of placement technique used to restore the cavities. Bonding agent was applied according to the manufacturer's instructions and light cured for 20 seconds. All specimens was restored with a nanohybrid composite resin.

Group I: Subjected to horizontal incremental technique.
At the cervical wall, the first increment was horizontally placed and light cured for 40 seconds. The second increment was horizontally placed contacting the buccal and axial walls and then subsequent layers was placed horizontally.
-Group II: Subjected to oblique incremental technique.
The first layer of the composite was placed obliquely contacting buccal and axial walls and the gingival floor, followed by light curing for 40 seconds, then subsequent layers was placed obliquely.
-Group III: Subjected to bulk filling technique.
In this technique composite was placed in a maximum 4-mm bulk due to their high reactivity to light curing.
After 24 hour storage in 1% Chloramine-B-Hydrate solution at room temperature, the restored tooth was subjected to the thermocycling. All the specimens was immersed alternatively in water baths at 5±2°C & 55±2°C for 500 cycles with a dwell time of 15 seconds. 2 layer of nail varnish was used on the teeth surfaces to isolate, except for 2.0 mm around the restoration. Then the specimen were immersed in a 2% methylene blue for 24 hours. The nail varnish was removed and the specimens were sectioned through the center of the restoration with water cooled slow speed diamond disk.
The sections was analyzed with a stereomicroscope and scored for the degree of dye penetration at cervical walls.

Criteria scores:
0 = No dye penetration
1 = Dye penetration extending to 1/3rd of the cervical wall
2 = dye penetration extending to 2/3rd of the cervical wall
3 = Dye penetration into whole of the cervical wall
4 = Dye penetration into the cervical wall & axial walls toward the pulp.

The data obtained were submitted to statistical analysis. One way ANOVA test was used for inter comparison of microleakage between the groups. ($p>0.05$)

Group1: Horizontal incremental technique	**Group 2**: Oblique incremental technique.	**Group 3:** Bulk placement technique
		

STATISTICAL ANALYSIS:
Statistical analysis was done by using descriptive and inferential statistics using one way ANOVA and Multiple Comparison Tukey Test and software used in the analysis were SPSS 17.0 version and EPI-INFO 6.0 version and $p<0.05$ is considered as level of significance.

RESULTS:

None of the techniques studied were capable of complete elimination of marginal microleakage and analysis of variance showed that the restoration techniques did not influence the values of microleakage in composite restoration.

No statistically significant differences were found between the group I and group II i.e. (horizontal incremental, oblique incremental technique) Oblique incremental technique and horizontal incremental technique showed less microleakage in gingival margins of the restorations compared to bulk placement technique.

DISCUSSION:

The aesthetic benefits, ease of use and bonding with the tooth structure, the composite restoration is widely used in clinical practice. When it is applied in a cavity with the adhesive system, it establishes a proper interaction with the both enamel and/or dentin, and the longitudinal stability is directly related to the steps resulting from cavity preparation, intrinsic characteristics of the adhesive and restorative materials, operational procedures and manipulative weather of the oral environment[8]. The additional important factor related to the longitudinal stability of composite restoration is its mechanism of polymerization shrinkage[9]. The marginal gap caused by the polymerization shrinkage and repeated occlusal loading may lead to microleakage which may causes problems like failure of adhesive bonding, secondary caries, sensitivity.

The present study compared the effect of different placement techniques on microleakage of class II composite restorations. The dye penetration technique was used for evaluation of microleakage in class II cavity as it is a simple, inexpensive, nontoxic, effective at low concentration and is frequent, and comparable method for evaluating microleakage.[10]

Table 1: Comparison of mean microleakage between the three groups

Descriptive Statistics

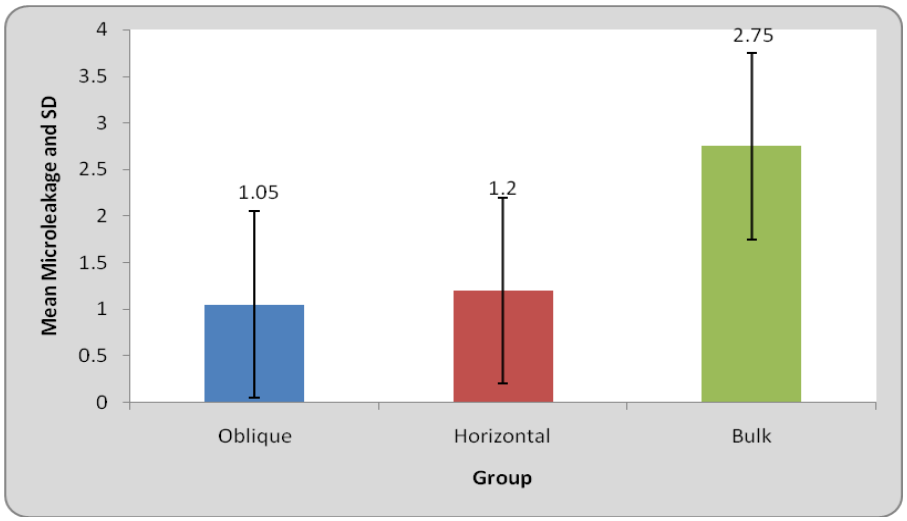
Group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Oblique	20	1.05	0.68	0.15	0.72	1.37	0.00	2.00
Horizontal	20	1.20	0.69	0.15	0.87	1.52	0.00	2.00
Bulk	20	2.75	0.78	0.17	2.38	3.11	2.00	4.00

One way ANOVA

Source of variation	Sum of Squares	Df	Mean Square	F	p-value
Between Groups	35.43	2	17.71	33.77	0.0001,S
Within Groups	29.90	57	0.52		
Total	65.33	59			

Multiple Comparison: Tukey Test

Group		Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Oblique	Horizontal	0.15	0.22	0.790,NS	-0.40	0.70
	Bulk	1.70	0.22	0.0001,S	1.14	2.25
Horizontal	Bulk	1.55	0.22	0.0001,S	0.99	2.10



Several studies reported that thermal changes in the oral cavity can affect the bond between tooth and restorative materials[11,12] therefore thermocycling procedure is performed in vitro studies in an attempt to simulate the in vivo conditions[13]. In this study permanent first and second molars were utilized because these teeth have a wide occlusal surface which is most suitable for class II cavity preparation and evaluation of dye penetration. Thirty sample size in three groups (n=10) were used for finding a significant difference in effect of different placement technique on microlekage of composite restoration. None of the techniques studied were capable of complete elimination of marginal microleakage and also analysis of variance showed that the restoration techniques did not influence the values of microleakage in composite restoration.

No statistically significant differences were found between the horizontal incremental and oblique incremental technique. The least microleakage values were observed in oblique incremental technique (gingivo-occlusal), and the most values seen in bulk placement technique. In this bulk placement technique, larger volume of composite is used to polymerized, that may increase the polymerization shrinkage and there is also high internal stresses generated in the material due to this loss of marginal integrity can occur.[14] When incremental technique was used for insertion of composite into the cavity there is significant reduction in microleakage, which could be due to reduced volume of the resin and the stress generated on the cavity walls and also due to more uniform and efficient polymerization of resin composite through its entire thickness[15].

Versluis A. et al. (1996) suggested incremental placement techniques as a major factor in reducing polymerization shrinkage[16] and Duarte S et al. stated that most common technique to restore class 2 preparations is the incremental oblique technique[7]. These incremental techniques is based on polymerizing with resin-based composite layers less than 2 mm thick and these technique can also help in obtaining good marginal quality and preventing distortion of the cavity wall (thus securing adhesion to dentin).

Limitations:

- In vitro studies are only a prediction of what may actually happen in vivo. Simulation of oral conditions such as thermal changes using thermocycling may be misleading since such clinical conditions are individual specific.
- Incomplete polymerization of the bulk restorations could be a source of error in this study since

CONCLUSION:

Within the limitations of this study, it can be concluded that the none of the techniques studied were capable of complete elimination of marginal microleakage. Oblique technique showed the most significant difference values with bulk placement technique, then with horizontal incremental technique.

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